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INTERNET TECHNOLOGIES IN OPTIMAL SELECTION OF TYPICAL OR STANDARDIZED MACHINE ELEMENTS

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ABSTRACT: The problem of internet technologies application in optimal selection of typical or standardized machine elements during the design process is considered in the paper. The data bases technology is proposed for storage, processing and access to the technical documentation data. The computer tools for engineering data bases and for internet applications creation are discussed. The internet application for optimal selection of rolling bearings is described as an example of application for selection of typical or standardised machine elements. In this example the optimisation criteria are discussed. Problem of polyoptimal selection is also considered and the method of polyoptimisation is proposed.

KEY WORDS: internet, data base, machine elements

1. INTRODUCTION

Information Technology (IT) but specially internet technologies continues to develop and diffuse at a rapid rate. Exponential quality improvements and cost reductions in microprocessors, storage, and networking are enabling new applications and the expanded use of IT, which is a manifestation of public and private investment in science and engineering (S&E) that is enabling broad and significant changes in society. Internet technologies can be applied in design process specially in selection of typical or standardized machine elements. For storage, processing and access to the technical documentation data the engineering data bases are very useful.

2. INTERNET APPLICATION FOR SELECTION OF ROLLING BEARINGS

In the Warsaw University of Technology the internet application for selection of rolling bearings was created [1,3]. Fig. 1 illustrates the user registration to this application.

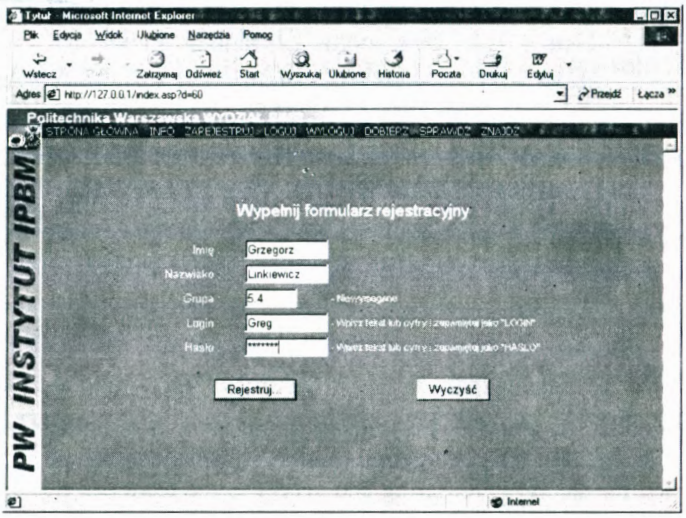

Fig. 1: Application for selection of rolling bearings – the user registration

The registrated user can select different types of rolling bearing produced by company FAG and SKF. After selection of the type of bearing user should introduce many data which are necessary for the selection. Fig. 2 is a screen copy for data introducing.

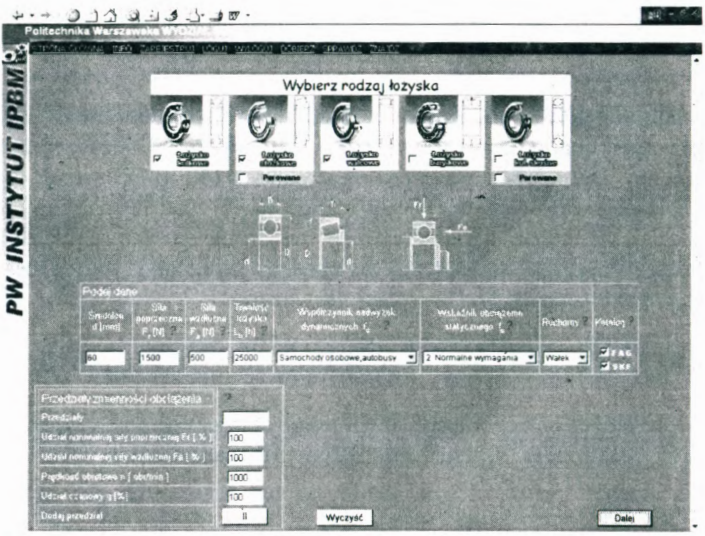

Fig. 2: Application for selection of rolling bearings – data introduction

In the application the method of bearing selection proposed by producers FAG or SKF is implemented. Fig. 3 illustrates some results of selection. Fig. 4 illustrates the results of calculations during the selection process.

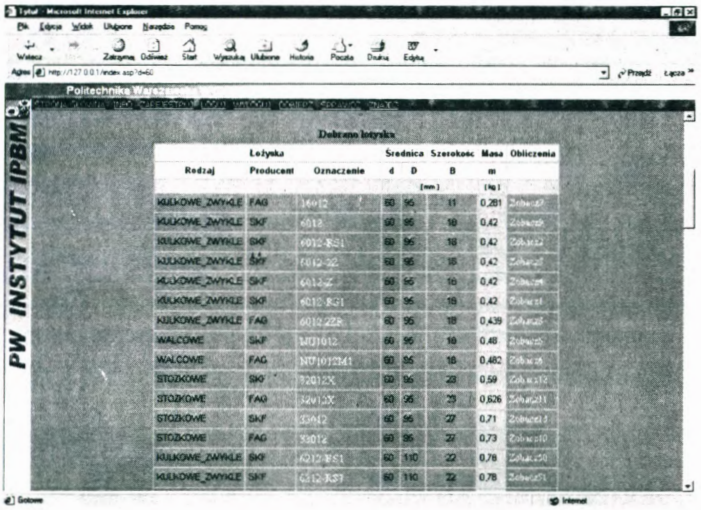

Fig. 3: Application for selection of rolling bearings – results of selection

3. POLYOPTIMISATION OF SELECTED ROLLING BEARINGS

Application can also be applied for polyoptymisation of selected rolling bearings. The following criteria are considered:

- Q_1 – cost of bearing
- Q_2 – mass of bearing
- Q_3 – width of bearing
- Q_4 – durability of bearing.

The method of Lagrange's factors is proposed as a method of polyoptimisation. In this method problem of polyoptimisation is replaced by optimisation problem with new criterion Q*(x) with Lagrange's factors ρ_l.

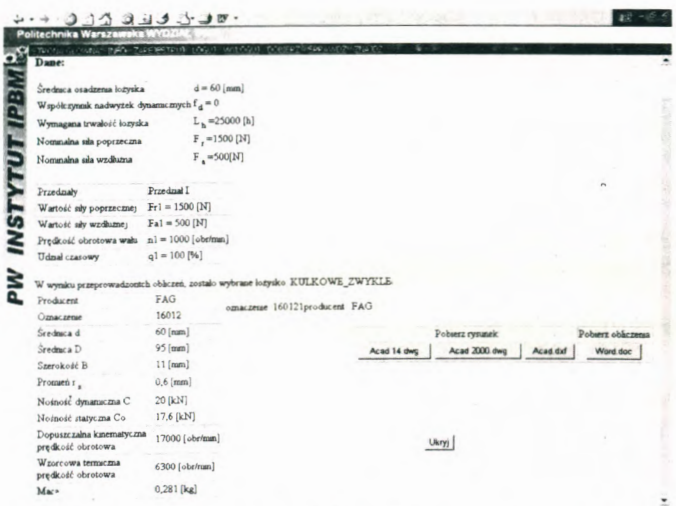

Fig. 4: Application for selection of rolling bearings – results of calculation

$$Q^*(x) = \sum_{i=1}^{n} \rho_i \cdot q_i(x), \tag{1}$$

$$\sum_{i=1}^{n} \rho_i = 1, \tag{2}$$

in our case:

$$Q^*(x) = \rho_1 \cdot Q_1 + \rho_2 \cdot Q_2 + \rho_3 \cdot Q_3 + \rho_4 \cdot Q_4 \tag{3}$$

The method of Lagrange's factors as a method of polyoptimisation require the normalization of particular criteria to the range [0, 1]. Normalization change criteria $q_i(x)$ into $q_i^*(x)$ according the formula (4):

$$q_i^*(x) = \frac{q_i(x) - q_i \min}{q_i \max - q_i \min}, \quad \text{where } q_i^*(x) \in [0,1], \tag{4}$$

and

$$q_i \min \rightarrow \min_{x \in \Phi} q_i(x), \; q_i \max \rightarrow \max_{x \in \Phi} q_i(x) \tag{5}$$

new normalized criterion is equal:

$$Q^{**}(x) = \sum_{i=1}^{n} \rho_i \cdot Q_i^*(x), \tag{6}$$

in our case:

$$Q^{**}(x) = \rho_1 \cdot Q_1^* + \rho_2 \cdot Q_2^* + \rho_3 \cdot Q_3^* + \rho_4 \cdot Q_4^* \tag{7}$$

Fig. 5 is a screen copy of optimisation panel. Fig. 6 presents some results of polyoptimisation for Lagrange's factors equal $\rho_1=0.7$, $\rho_2=0.1$, $\rho_3=0.1$, $\rho_4=0.1$.

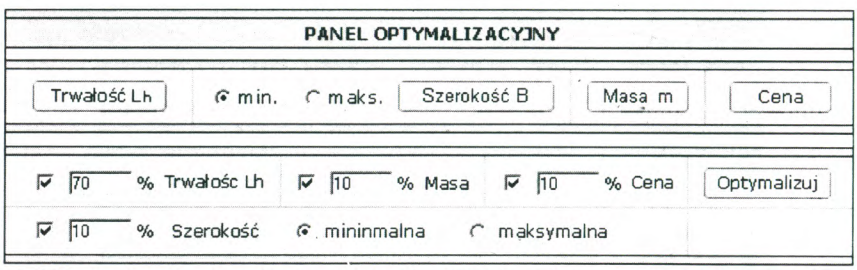

Fig. 5: Application for selection of rolling bearings – optimisation panel

Fig. 7 illustrates indroduction of selected polyoptimal rolling bearing to AutoCAD drawing.

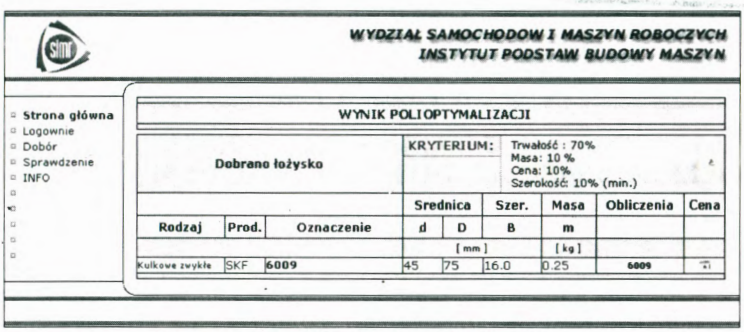

Fig. 6: Results of polyoptimisation

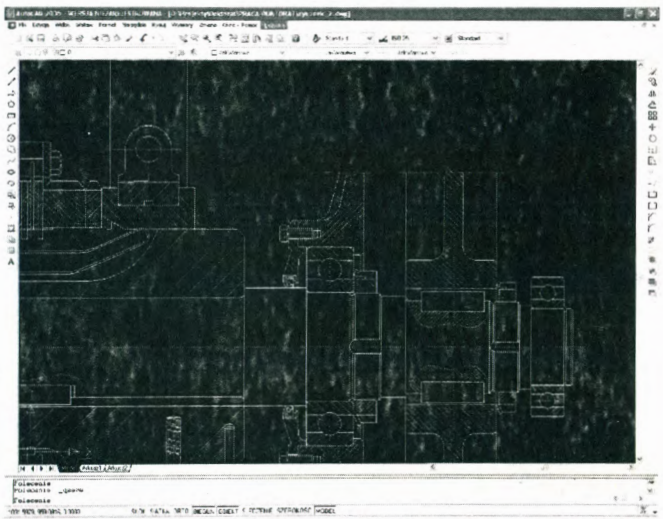

Fig. 7: Application for selection of rolling bearings – AutoCad drawing

4. CONCLUSIONS

In the paper the data bases technology (MS Access and AutoCAD) is proposed for storage, processing and access to the technical documentation data. The internet application for selection of rolling bearings is described. In this application the optimisation criteria are discussed. Problem of polyoptimal selection is also considered and the method of polyoptimisation is proposed. This internet application is applied in the teaching process in Warsaw University of Technology and also in industrial design offices.

5. REFERENCES

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